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[Title of the Invention] ORGANIC EL DISPLAY APPARATUS AND METHOD FOR DRIVING AN ORGANIC EL DEVICE

[Abstract]

[Object] In the case of conducting display by using a light-emitting display panel, the panel may be seen differently depending upon a use environment even at the same light-emission brightness. A small and light-weight organic EL apparatus is realized which solves the above-mentioned problem without using an external sensor, and is capable of conducting an easy-to-see display without using an excess electric power.

[Means for Solving the Problem] By measuring a current value when a predetermined voltage is applied to an organic EL device, the intensity of light illuminated to an organic EL panel and the temperature of the organic EL panel are measured. The light-emission brightness of the organic EL panel is adjusted to be optimum in a driving circuit, based on the information thus obtained, so that light is emitted brightly at a light place without using an external

sensor, and light is emitted not too brightly at a dark place, whereby an easy-to-see and clear display state is realized.

[Claims]

[Claim 1] An organic EL display apparatus comprising: a display element organic EL device for displaying information; and an organic EL device for measurement for measuring temperature or illumination.

[Claim 2] An organic EL display apparatus according to claim 1, wherein the organic EL device for measurement separately includes an organic EL device for temperature measurement for measuring temperature, and an organic EL device for illumination measurement for measuring illumination.

[Claim 3] An organic EL display apparatus according to claim 1 or 2, wherein the display element organic EL device and the organic EL device for measurement are provided on an identical organic EL panel.

[Claim 4] An organic EL display apparatus for measurement according to claim 2, wherein the organic EL device for temperature measurement and the organic EL device for illumination measurement have an identical area.

[Claim 5] An organic EL display apparatus according to claim 2, wherein the organic EL device for illumination measurement is light-shielded with a housing incorporating the display element organic EL device.

[Claim 6] An organic EL display apparatus, comprising: a display element organic EL device for displaying information; an organic EL device for measurement for measuring temperature or illumination; a correction data generation circuit for creating correction data based on measurement results of the organic EL device for measurement; and a driving circuit for applying a driving waveform in accordance with the correction data and display data to the display element organic EL device.

[Claim 7] A method for driving an organic EL device, wherein a current value is measured by applying a voltage to an organic EL device that is being illuminated with light, thereby measuring intensity of light illuminated to the organic EL device, and light-emitting intensity of the organic EL device is corrected based on the measurement results.

[Claim 8] A method for driving an organic EL device, wherein a current value is measured by applying a voltage to an organic EL device that is being illuminated with light, thereby measuring intensity

of light illuminated to the organic EL device, and light-emitting intensity of an organic EL device for display is corrected based on the measurement results.

[Claim 9] A method for driving an organic EL device, wherein a current value is measured by applying a voltage to an organic EL device that is light-shielded so as not to be illuminated with external light, thereby measuring temperature of the organic EL device, and light-emitting intensity of the organic EL device is corrected based on the measurement results.

[Claim 10] A method for driving an organic EL device, wherein a current value is measured by applying a voltage to an organic EL device that is light-shielded so as not to be illuminated with external light, thereby measuring temperature of the organic EL device, and light-emitting intensity of an organic EL device for display is corrected based on the measurement results.

[Claim 11] A method for driving an organic EL device according to any one of claims 7 to 10, wherein the voltage applied to the organic EL device is a reverse bias.

[Claim 12] A method for driving an organic EL device, wherein a difference between a current value measured by applying a voltage

to an organic EL device that is being illuminated with light and a current value measured by applying a voltage to the organic EL device that is light-shielded so as not to be illuminated with external light is used as light intensity to correct light-emitting intensity of the organic EL device.

[Claim 13] A method for driving an organic EL device, wherein a difference between a current value measured by applying a voltage to an organic EL device for illumination measurement that is being illuminated with light and a current value measured by applying a voltage to an organic EL device for temperature measurement that is not being illuminated with external light is used as light intensity to correct light-emitting intensity of an organic EL device for display.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention relates to an organic EL display apparatus having an organic EL device, and a method for driving the organic EL device. The present invention also relates to a correction circuit for conducting display with optimum light-emitting intensity at all times by varying light-emitting intensity of a display element depending upon an external environment in which an organic EL panel is placed.

[0002]

[Prior Art] FIG. 5 is a block diagram showing a method for driving a conventional organic EL device. Furthermore, FIG. 6 is a plan view showing an external appearance of a conventional organic EL display module. Temperature information and external illumination information are supplied respectively from a temperature sensor 51 and an illumination sensor 52 to a detection circuit 53. The detection circuit 53 converts the temperature information and illumination information sent in an analog form into digital data and send it to a correction data generation circuit 54. The correction data generation circuit 54 determines light-emission brightness by calculation processing previously determined based on detection data and characteristics of the organic EL device, and supplies it to a driving circuit 55 as correction data. The driving circuit 55 generates a driving waveform from the correction data and display data and applies it to the organic EL panel 56.

[0003] As shown in FIG. 6, conventionally, the temperature sensor 64 and the light sensor 65 are prepared separately from the organic EL panel 62, and disposed in an organic EL display module 61. As the temperature sensor 64, a thermistor, a thermocouple, etc. are used. As the illumination sensor, a photodiode, a phototransistor, etc. are used. Furthermore, the detection circuit 53, the correction

data generation circuit 54, and the driving circuit 55 are disposed behind the organic EL display module 61.

[0004] Because of the above-mentioned structure, the organic EL panel 56 emits light at brightness corrected with temperature and external illumination, whereby light is emitted brightly at a light place, and emitted not too brightly at a dark place.

[0005]

[Problems to be Solved by the Invention] In the case where a light-emitting display panel is used as a display unit, the panel is seen differently even at the same light-emission brightness, depending upon a use environment. Light-emission brightness is increased in strong external light such as sunlight, and light-emission brightness is decreased in a dark room such as a darkroom, whereby an easy-to-see and clear display can be conducted. Furthermore, in a display unit of portable equipment such as a watch, due to battery activation, miniaturization and low power are required, and appropriate light-emission brightness is set depending upon a use environment, whereby an excess electric power can be saved. Therefore, according to the conventional structure and method, the illumination sensor 65 and the temperature sensor 64 are provided separately from the organic EL panel 62 and the driving circuit 55. Accordingly, the organic EL display module 61 is increased in

size, which results in an expensive apparatus. Furthermore, since the sensors are disposed separately from the organic EL panel, an error may occur.

[0006]

[Means for Solving the Problem] According to the method for driving an organic EL device of the present invention, as means for solving the above-mentioned problem, by measuring a current value when a predetermined voltage is applied to an organic EL device, intensity of light illuminated to the organic EL panel and temperature of the organic EL panel are measured. Based on the information thus obtained, light-emission brightness of the organic EL panel is appropriately adjusted in a driving circuit. Because of this, an easy-to-see and clear display can be conducted even in an environment with different illuminations without using an external sensor.

[0007]

[Embodiment of the Invention] Hereinafter, an embodiment of an organic EL display apparatus and a method for driving an organic EL device according to the present invention will be described. More specifically, the organic EL display apparatus of the present invention includes a display element organic EL device for displaying information and an organic EL device for measurement for measuring temperature or illumination. Light-emission intensity of the

organic EL display apparatus is corrected based on the temperature or illumination measured by the organic EL device for measurement, whereby light-emission brightness can be adjusted depending upon an ambient environment.

[0008] Herein, if, as organic EL devices for measurement, an organic EL device for temperature measurement for measuring temperature and an organic EL device for illumination measurement for measuring illumination are provided, and light-emission intensity of the organic EL display apparatus is corrected as described above, display with optimum brightness in an ambient environment (temperature, lightness) can be conducted. Furthermore, an organic EL device used for display and an organic EL device for measurement can be provided in the identical organic EL panel.

[0009]

[Embodiment] FIG. 1 shows a block diagram of a method for driving an organic EL device of the present invention. A current value is measured when a predetermined voltage is applied to an organic EL device for temperature measurement and an organic EL device for illumination measurement provided in an organic EL panel 14, whereby a current detection circuit 13 receives temperature information and illumination information and sends them to a correction data generation circuit 11.

[0010] The correction data generation circuit 11 sends correction data to a driving circuit 12, based on a relationship between the data obtained from the current detection circuit 13, and the previously set illumination and light-emission brightness. The driving circuit 12 generates a driving waveform from the correction data and display data and applies the driving waveform to the organic EL panel 14, thereby allowing light to be emitted at optimum brightness suitable for an external environment. Table 1 shows results obtained by applying 5 volts to the organic EL device at a reverse bias and measuring a current value.

[0011]

[Table 1]

Area of an organic EL device 2 mm^2

Temperature 25° C

Illumination (1 ×)	Current value (μA)
320	3.0
2500	3.5

[0012] FIG. 2 is a plan view of an organic EL panel 21 according to the present invention. In the organic EL panel 21, 7-segment display elements 22 in a relatively large 8-shape are provided in four digits on a left side, and 7-segment display elements in a

relatively small 8-shape are provided in two digits on a right side. This panel is a light-emitting display panel for displaying a time, in which the four digits on the left side represent an hour and a minute, and two digits on the right side represent a second. Furthermore, in addition to the 7-segment display elements 22, an EL device 23 for illumination measurement is provided inside a parting line, and an EL device 24 for temperature measurement is provided at a position that is light-shielded with a housing or an outer housing of a module.

[0013] FIG. 3 shows a circuit diagram illustrating a specific example of a method for driving an organic EL device of the present invention. Switches 303 and 304 are attached to terminals of an EL device 302 for display, and a state where the EL device 302 for display is connected between a driving circuit 309 and a GND to conduct display, and a state where the EL device 302 for display is connected to V_{cc} and a current detection circuit 301 to measure illumination are switched. In the present example, since illumination can be measured with a high voltage of about 5 volts, so that a reverse bias is supplied. However, a forward bias may be used as long as a voltage does not allow light to be emitted.

[0014] In the current detection circuit 301, the switch 303 is connected to a resistor 305, and voltages at both ends of the resistor

305 are detected, whereby a current value is measured. More specifically, the voltages at both ends of the resistor 305 are amplified with a voltage amplifying circuit 306, and thereafter, the amplified voltages are converted into digital data by an A/D converter 307 and are output as detection data. In the correction data generation circuit 308, light-emission brightness is determined based on the data detected by the current detection circuit 301, and a relationship between the illumination and the optimum light-emission brightness of the organic EL device 302 previously prepared by a ROM or the like, and the correction data is output to the driving circuit 309.

[0015] In the driving circuit 309, a driving waveform is generated from the correction data and the display data, whereby the EL device 302 for display is allowed to emit light. Furthermore, during emission of light, a sync-signal generation circuit 310, in which the switch 303 is connected to the driving circuit 309, and the switch 304 is connected to GND, generates and supplies a synchronization signal required for the switches 303, 304, the A/D converter 307, the correction data generation circuit 308, and the driving circuit 309.

[0016] FIG. 4 is a circuit diagram illustrating a specific example of a method for driving an organic EL device of the present invention.

In the organic EL panel 402, an EL device 404 for illumination measurement and an EL device 405 for temperature measurement are produced during the identical step in addition to an EL device 403 for display. The EL device 405 for temperature measurement is provided at a position where light-shielding is effected with a housing or an external frame. In a current detection circuit 401, a switch 406 is connected to the EL device 404 for illumination measurement or the EL device 405 for temperature measurement, thereby switching between temperature measurement and illumination measurement. More specifically, first, the switch 406 is connected to the EL device 404 for illumination measurement, the voltages at both ends of the resistor 407 are amplified by the voltage amplifying circuit 408, and thereafter, the voltages are converted into digital data by the A/D converter 409, whereby illumination data containing a temperature error is output. Then, the switch 406 is connected to the EL device 405 for temperature measurement, and the similar measurement is conducted, whereby temperature data is output.

[0017] In the correction data generation circuit 410, temperature data is subtracted from the illumination data detected by the current detection circuit 401 to obtain illumination data, and optimum light-emission brightness is determined and correction data is output to a driving circuit 410. Relationships between the

illumination and the optimum light-emission brightness and between the temperature and the light-emission brightness are previously prepared by a ROM or the like in a similar manner to the above-mentioned case. In the driving circuit 410, a driving waveform is generated from the correction data and the display data, whereby the EL device 403 for display is allowed to emit light. A sync-signal generation circuit 412 generates and supplies a synchronization signal required for the switch 406, the A/D converter 409, the correction data generation circuit 410, and the driving circuit 411.

[0018] Herein, as a current measurement method, those other than a method for inserting a resistor and measuring voltages may be used. Furthermore, the A/D, the correction data generation circuit, and the driving circuit may conduct processing in an analog manner instead of a digital manner.

[0019]

[Effect of the Invention] By using the method for driving an organic EL device of the present invention, display is conducted at light-emission brightness suitable for an external environment without using an external sensor, and a small and light-weight organic EL display module can be provided that is capable of conducting an easy-to-see display. Therefore, when the present invention is applied to products requiring miniaturization, a low power, a low

cost, and a fashion property, such as a watch, completeness as a product can be enhanced. Thus, the use of the present invention has a great effect.

[Brief Description of the Drawings]

[Figure 1] A block diagram showing a method for driving an organic EL device of the present invention.

[Figure 2] A plan view of an organic EL panel driven by the method for driving an organic EL device shown in FIG. 1.

[Figure 3] A circuit diagram illustrating the method for driving an organic EL device of the present invention.

[Figure 4] A circuit diagram illustrating another method for driving an organic EL device of the present invention.

[Figure 5] A block diagram showing a conventional example.

[Figure 6] A plan view of an organic EL display module showing a conventional example.

[Description of the Reference Numerals]

11, 308, 410, 54 Correction data generation circuit

12, 309, 411, 55 Driving circuit

13, 301, 401 Current detection circuit

14, 21, 402, 56, 62 Organic EL panel

22, 302, 403, 63 EL device for display

23, 404 EL device for illumination measurement

24, 405 EL device for temperature measurement

303, 304, 406 Switch

305, 407 Resistor

306, 408 Voltage amplifying circuit

307, 409 A/D converter

310, 412 Sync-signal generation circuit

311, 413 CPU

51, 64 Temperature sensor

52, 65 Illumination sensor

53 Detection circuit

61 Organic EL display module